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(54) **SEAM WELDING APPARATUS.**

(57) A seam welding apparatus characterized in that a metal sheet or surface coated metal sheet is shaped cylindrically, a base metal (4) having an overlap portion S with which both side edges of the metal sheet or th surface coated metal sheet overlap in a belt form is inserted between a pair of electrod rollers (1) and (2) with a wire electrode (3) being wound around the r ll rs, the overlap porti n S is clamped and pressed between the electrode rollers (1), (2) and the wire electrode (3) to effect seam welding and furthermore there is provided a welding current power source (8) for supplying a welding current to between the electrode rollers (1) and (2). A detector (6) for detecting at least the forward end (4a) of the base metal (4) is disposed on a line L connecting the respective rotary shafts (1a), (2a) of the electrode rollers (1), (2) and the output side of this detector (6) is connected to a control circuit (7) which calculates the feed start timing and feed stop timing of the welding current to the electrode rollers (1), (2) based on the result of detecti n by the detector (6) and instructs the welding current power source (8) to start or stop the supply of the w lding current based on these timings.

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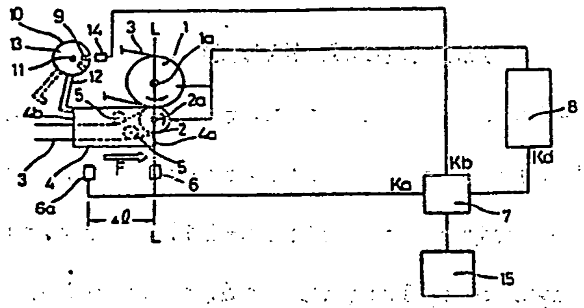
Fig. 2



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TECHNICAL FIELD

This invention relates to an apparatus for seam welding, in which a metal plate or a surface-clad metal plate in a cylindrical form with a strip-like overlap section constituted by two overlapping edge portions is passed between pair roller electrodes via upper and lower wire electrodes for seam welding of the overlap section between the roller electrodes and also between the upper and lower wire electrodes under pressure applied to the section, and also which is provided with a welding current source for supplying a welding current between the roller electrodes.

BACKGROUND TECHNIQUES

It is well known in the art that a weld zone having excellent leakage-proof property can be obtained by seam welding, which is a well-known process of resistance welding. For this reason, seam welding is used for the welding of liquid transportation pipes, fuel tanks , drum cans and food cans. Among various seam welding process, lap seam welding is most usual. In the lap seam welding, a steel plate or like process material is fed such that an overlap section constituted by two overlapping edge portions is clamped between a pair of,

i. ., upp r and l wer, disk-like lectr des. As the material is fed with pressure applied to the overlap section, current is passed intermittently between the upper and lower roller electrodes to effect thermal fusion and welding by joule heat produced at this time. In this welding process, a large current can be passed in a short period of time to provide an increased welding speed. For this reason, the process is suited for mass production. In addition, unlike the spot welding, nuggets are formed continuously during the current supply such that adjacent nuggets overlap each other, thus forming a continuous weld zone. Therefore, the seam welding permits weld joints having excellent-air and water-tightness to be obtained and is thus said to be suitable for manufacturing food cans and drink cans.

However, the food cans and drink cans are required to provide corrosion resistance with respect to the contents. For this reason, cold-rolled steel sheets are not used directly as material, but usually tin-plated or like clad steel sheets are used. When the clad steel sheet material is subjected to seam welding in the state that it is clamped between upper and lower roller electrodes, the covering metal such as tin that is present on the surface migrates to and contaminates the outer periphery, i.e., contact surface, of the roller electrodes. Therefore, in many cases it is necessary to remov th covering metal

in order to obtain satisfactory welding.

To solve this problem, there has been proposed and practiced an apparatus for lap seam welding via wire electrodes, as disclosed in Japanese Patent Publication 25,213/1969. In this lap seam welding apparatus, as shown in Fig. 1, upper and lower roller electrodes 1 and 2 are supported for rotation about respective axes 1a and 2a. Wire electrodes 3 such as copper wire are passed round the roller electrodes 1 and 2. An overlap section S of a material 4 in a cylindrical form is guided continuously between these wire electrodes 3 to be seam welded via the wire electrodes 3. In this case, the upper and lower roller electrodes 1 and 2 are rotated continuously. The upper and lower electrodes 1 and 2 have respective guide grooves formed in the outer periphery. The wire electrodes 3 are received in these guide grooves and are fed together with the material 4 with the rotation of the upper and lower roller electrodes 1 and 2. Current is applied between the upper and lower roller electrodes 1 and 2 only while the material 4 is passed between the wire electrodes 3, whereby the overlap section S is thermally fused under pressure and welded.

With the prior art seam welding apparatus, however, it is difficult to detect the leading and trailing ends Sa and Sb of the overlap section S. Further, although it is

necessary to vary the supplied welding current for the leading and trailing ends Sa and Sb and intermediate portion Sc other than the ends Sa and Sc, the djustment is very difficult. Unless the adjustment is satisfactory, the welding performance is deteriorated.

DISCLOSURE OF THE INVENTION

As noted above, the invention concerns an apparatus for seam welding, in which a metal plate or a surface-clad metal plate in a cylindrical from with a strip-like overlap section constituted by two overlapping edge portions is passed between a pair of roller electrodes via upper and lower wire electrodes for seam welding of the overlap section between the roller electrodes and also between the upper and lower wire electrodes under pressure applied to the section, and also which is provided with a welding current source for supplying a welding current between the welding electrodes.

One feature of the invention resides in that a detector for detecting at least the leading end of the material being fed is provided on a straight line connecting the axes of rotation of the roller electrodes, and the output side of the detector is connected to a control circuit, which counts the start and stop timings of supply of welding current to the roller electrodes and instructs the start and stop of the welding current supply

to the welding current sourc according to counted start and stop timings. Thus, a predetermined welding current is supplied only while the material passes between the pair roller electrodes to obtain satisfactory seam welding of the material.

Another feature of the invention resides in that a feeder for feeding the overlap section into between the roller electrodes by pushing the rear end of the material is provided, the feeder including a disk-like member rotatable about a shaft a slit provided in the disk-like member and a feed arm having one end mounted on the shaft, and an approach switch is provided for detecting the position of the slit, the output side of the approach switch is provided for detecting the position of the slit, the output side of the approach switch is connected to the control circuit. Thus, the material can be fed very accurately, and the ends of the material can be detected accurately and without any deviation.

A further feature of the invention resides in that an approach switch for detecting the position of the slit provided in the disk-like member of the feeder is provided such that its output side is connected to the control circuit, and a detector for detecting at least the leading end of the material is provided at a position, which is spaced apart from the straight line connecting the axes of rotation of the roll r electrodes in the

direction opposite to the direction of f eding of th material by predetermined distance smaller than the length dimension of the material. Thus, it is possible to provide the detector at a position spaced apart from the neighborhood of the roller electrodes, so that a logical structure can be obtained.

A still further feature resides in that an adjusting circuit, which sets a welding current necessary for the welding of the intermediate portion of the overlap section of the material except for the opposite ends of the section and also sets a welding current necessary for welding the opposite end portions of the overlap section, is connected to the control circuit. It is thus possible to hold the current necessary for the welding of the intermediate portion of the overlap section to be high compared to the current for welding the end portions of the overlap section.

A yet further feature of the invention resides in that the adjusting circuit connected to the control circuit sets a welding current necessary for welding the intermediate portion of the overlap section of the material and also sets a welding current necessary for the welding of the end portions of the overlap section other than the intermediate portion. Thus, variations of welding conditions such as frequency and welding speed can be sufficiently coped with by merely adjusting the current

or voltage necessary for the welding of the intermediate portion of the overlap section.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a state, in which an overlap section of material is seam welded between a pair of roller electrodes via wire electrodes;

Fig. 2 is a schematic representation of an embodiment of the apparatus for seam welding according to the invention;

Fig. 3 shows the manner of detection of the ends of material in the seam welding apparatus according to the invention, with an illustration of end detection process shown in an upper portion, and a detection signal and a welding current corresponding to the end detection process shown in a lower portion;

Figs. 4(a), (b), (c), (d) and (e) are time chart diagrams for explaining the process of controlling the welding current or the like in the seam welding apparatus shown in Fig. 2;

Figs. 5(a) and 5(b) are schematic representations of respective examples of the adjusting circuit; and

Fig. 6 shows the manner of control of the welding current in the adjusting circuits shown in Figs. 5(a) and 5(b).

BEST FORMS OF CARRYING OUT THE INVENTION

Referring to Fig. 2, reference numerals 1 and 2 designate disk-like roller electrodes, numeral 3 wire electrodes, numeral 4 process material, and numeral 5 wire guide rollers. Roller electrodes 1 and 2 are rotatably supported by an arm supporting mechanism (not shown) or the like. By these support mechanisms, a pressure is applied to the overlap section S (see Fig. 1) so that the stripe-like edge portions of the overlap section S are urged against each other. Further, wire electrodes 3 are pulled by the rotational force of a motor (not shown). By this pulling force, the roller electrodes 1 and 2 are rotated. The process material 4 consists of a metal sheet in the cylindrical form, and it is fed in the direction of arrow F. The overlap section S of the process material 4 is clamped between the roller electrodes 1 and 2 via upper and lower wire electrodes 3.

In Fig. 2, a detector 6, e.g., an approach switch, is provided on a line connecting the axes of shafts 1a and 2a of the upper and lower roller electrodes 1 and 2. The detector 6 detects the process material 4 to be welded, more specifically, the leading end 4a and trailing ends 4b of the process material 4. The detector 6 supplies a detection signal to a control circuit 7. A welding current is supplied from a welding current source circuit

8 to be applied between the upper and lower roller electrodes 2 and 3. The welding current is supplied according to an instruction value supplied from the control circuit 7.

With the above construction, the control circuit 7 effects control of the welding current supplied from the welding current source circuit 8 to between the roller electrodes 1 and 2, as shown in Fig. 3, according to the detection signal supplied from the detector 6. In Fig. 3, the uppermost drawing shows the position of the process material 4 with respect to the roller electrodes 1 and 2, the intermediate graph shows the detection signal of the detector 6 corresponding to the position of process material, and the lowermost graph shows the corresponding welding current caused through the process material 4. Shown at T_1 is a time instant before the leading end 4a of the process material 4 reaches the line connecting the axes of the shafts 1a and 2a of the roller electrodes 1 and 2, i.e., welding start line L, T_2 is a time instant when the leading end 4a passes through the welding start line L, T_3 is a time instant after the leading end 4a passes through the welding start line L, T_4 is a time instant before the trailing end 4b of the process material 4 reaches the welding start line L, T_5 is a time instant when the trailing end 4b reaches the welding start line L, and T_6 is a time instant after the trailing end 4b

reaches the welding start line L. When th leading end 4a of the process material 4 reaches the welding start line L between the roller electrodes 1 and 2, it is detected by the detector 6. At the instant T_2, the output of the detector 6 rises from "L" level to "H" level. At the instant T_5 of reaching of the welding start line L by the trailing end 4b of the process material 4, the output of the detector 6 goes to the "L", i.e., zero, level. While the detection signal at "H" level is supplied from the detector 6, the control circuit 7 supplies to the welding current source circuit 8 an instruction to provide a welding current Iw having a predetermined level. Thus, during a period from instant T_2 till instant T_5, welding current Iw is applied between the roller electrodes 1 and 2, and the welding current is supplied from the welding current source circuit 8 while and only while the process material 4 passes between the upper and lower roller electrodes 1 and 2.

Where the detector 6 is provided on the welding start line L, a mechanism for maintaining a constant extent of overlap of the overlap section S of the process material 4 and a mechanism for supporting the roller electrodes 1 and 2 are provided in the neighborhood of the welding start line L. Sometimes, the provision of the detector 6 on the welding start line L is undesired due to structural

and design-wis reasons.

For example, the detector 6 such as an approach switch has to be provided at a position, at which there is no design-wise or structural problem, such as a position shown by a dashed line in Fig. 2, spaced apart by a distance Δl from the welding start line L. In this case, a feeder 10 is constructed such that it consists of a disk-like member 13 and a feed arm 12 having one end mounted on the shaft 11 of the disk-like member 13. Further, a detection slit 9 is provided on the disk-like member 13 of the feeder 10, and an approach switch 14 is provided in relation to the detection slit 9. The position of the detection slit 9 is detected by the approach switch 14, and the detection signal therefrom is supplied to the control circuit 7.

More specifically, when the detector 6 is disposed at a position 6a shown by dashed lines in Fig. 2, i.e., a position spaced apart by distance Δl in the direction opposite to the direction F of feeding the process material 4 from the welding start line L, the leading end 4a reaches the welding start line L at an instant after the lapse of a predetermined period of time from the detection of the leading end 4a of the process material 4 by the position detector 6a. In this case, when the feeder 10 is not constructed in the manner as described above but consists of a chain conveyer (not shown), the

period from an instant when the leading end 4a of the process material 4 being fed by the chain conveyer passed by the detector 6 at the position shown by the dashed lines till an instant when the leading end 4a reaches the welding start line L, is can be difficulty held constant even if the distance Δl is constant. More specifically, when a slip is produced in the process material 4, the speed of movement is reduced, and when the leading end 4a of the process material 4 is clamped between the upper and lower roller electrodes 1 and 2, it receives resistance. Since the resistance varies with the individual cases, the rate of reduction of the speed of movement of the proc ss material 4 is varied, so that the period noted above can not be held constant. In consequence, a deviation is produced between the timing of reaching of the welding start line L by the leading end 4a of the process material 4 and the timing the start of supply of the welding current between the roller electrodes 1 and 2. In this case, it is difficult to effect welding under proper welding conditions.

In this case, with the feeder 10 consisting of the rotatably supported shaft 11, feed arm 12 provided on the shaft 11 and disk-like member 13 rotated by the shaf 11, as shown in Fig. 2, with the rotation of the position shown by the dashed lines to the position shown by the solid lines in Fig. 2, the free end of the feed arm 12

pushes the process material 4 in contact with the trailing end 4b of the process material 4. Thus, the overlap section S is led into between the roller electrodes 1 and 2, so that the feeding of the process material 4 can be effected as rotation of the disk-like member 13. The disk-like member 13 of the feeder 10 is formed at a predetermined position with a slit 9. The feeding of the process material 4 thus is obtained as the position of the slit 9. An approach switch 14 is provided in the neighborhood of the disk-like member 11 for detecting the slit 9. When the leading end 4a of the process material 4 reaches the welding start position L, it detects the slit 9. When it detects the slit 9, it provides a "L" level detection signal.

The detector 6a which detects the process material 4, i.e., the leading end 4a and trailing end 4b of the material 4, is disposed at a position shown by the dashed lines, spaced apart from the welding start line L in the direction opposite to the direction F of feeding of the process material 4 by a predetermined distance Δl smaller than the length dimension of the process material 4. The control circuit 7 generally consists, generally, of a timer or logic circuit. The control circuit 7 calculates the start and stop timings of supply of welding current to between the roller electrodes 1 and 2 according to detection signals Ka and Kb provided respectively from

the detector 6a and appr ach switch 14. According to these timings, it produces a welding current supply pattern, i.e., a welding current supply pattern, in which the welding current is gradually increased during a period preset by a setter from zero to a predetermined value, then held at a predetermined value, and then gradually reduced during a period preset by the setter from the predetermined value to zero. According to this supply pattern, it instructs the welding current source circuit 8 to provide the welding current.

Now, the operation in case when the detector is moved by distance Δl to the position 6a shown by dashed lines in Fig. 2 will be described with reference to the timing diagrams of Figs. 4(a), 4(b), 4(c), 4(d) and 4(e).

Fig. 4(a) shows a detection signal Ka of the detector 6b, Fig. 4(b) shows a detection signal Kb of an approach switch 14, Fig. 4(c) shows a signal Kc obtained from the detection signals ka and Kb, Fig. 4(d) shows a signal Kd obtained from the signal Kc, and Fig. 4(e) shows a pattern of supply of welding current Iw obtained according to the signal Kd.

The detection signal Ka provided from the detector 6a rises from "L" level to "H" level when the leading end 4a of the process material 4 reaches a position above the detector 6a and is returned to "L" level at the instant T_2 when the trailing end 4b of the process material 4, passed

by the detector 6a (see Fig. 4(a)). The detection signal Kb provided from the approach switch 14 goes to "L" level at the instant T_1 when the leading end 4a of the process material 4 reaches a position between the roller electrodes 1 and 2 and then is immediately returned to "H" level (see Fig. 4(b)). In the control circuit 7, a signal Kc, which is at "H" level during a period from the instant T_1 till the instant T_2, is obtained according to the detection signals Ka and Kb (see Fig. 4(c)), and then a signal Kd is obtained, which goes to "H" level at an instant after the lapse of a preset time ΔT_1 from the instant T_1, and goes to "L" level at an instant after the lapse of a preset time ΔT_2 from the instant T_2, according to the signal Kc (see Fig. 4(d)). It is possible to obtain the instant of reaching of the position between the roller electrodes 1 and 2 by the leading end 4a of the process material 4 and the instant of reaching of the position between the roller electrodes 1 and 2 by the trailing end 4b of the process material 4 accurately by adjusting the preset times ΔT_1 and ΔT_2 to suitable values. More specifically, the instant of reaching of the position between the roller electrodes 1 and 2 by the leading end 4a of the process material 4 is obtained from an instant after the lapse of a suitable preset time ΔT_1 for correcting the error detection from the instant of inversion of the detection signal Kb of the

approach switch 14 to " L" level. The instant of reaching of the position between the roller electrodes 1 and 2 by the trailing end 4b of the process material 4, is obtained from the instant after the lapse of a preset time ΔT_2 corresponding to the time of movement of the process material 4 by distance Δl from the instant of inversion of the detection signal Ka of the detector 6a to "L" level. Subsequent to the instant when the process material 4 is no longer detected by the detector 6a, the material 4 is clamped between the roller electrodes 1 and 2 to be moved at a constant speed same as the rotational speed of the roller electrodes 1 and 2 by strongly receiving the restraining forces of the roller electrodes 1 and 2. Thus, at an instant after the lapse of a predetermined period T_2 of time from the instant when the material 4 is no longer detected by the detector 6a, it can be regarded that the trailing end 4b of the process material 4 has reached the position between the roller electrodes 1 and 2. Thus, the preset times ΔT_1 and ΔT_2 can be set to suitable values by a setter (not shown).

Now, the control circuit 7 produces a welding current supply pattern according to the signal kd shown in Fig. 4(d) and gives the welding current source circuit 8 an instruction to provide a trapezoidal pattern welding current as shown in Fig. 4(e) according to the supply pattern. Thus, the welding current source circuit 8

provides a welding current having a pattern that it is gradually increased from zero to Iw until the lapse of a preset time ΔTu from an instant $T_1 + \Delta T_1$, then is held at the level Iw and then gradually reduced from Iw to zero until the lapse of a preset time ΔTd from an instant $T_2 + \Delta T_2$. The preset times ΔTu and ΔTd can be suitably set by a setter (not shown).

The welding current is adapted to rise and fall with a slope at the start and stop of supply of the welding current in order that the welding current supplied to the ends of the overlap section S be held in a proper range even in case when a detection error is produced in the detector 6a and approach switch 14 or the preset values ΔT_1 and ΔT_2 are not proper so that the welding current start and stop timings are deviated with respect to the leading end 4a and trailing end 4b of the process material 4 are deviated.

Further, when the welding current from the welding current source circuit 8 is controlled by the control circuit 7 according to the detection signals supplied thereto from the detectors 6 and 6a as shown in Fig. 2, it is possible to connect an adjusting circuit 16 to the control circuit 7 in order to adjust the welding current for the leading and trailing end portions Sa and Sb of the overlap section S and that for the intermediate portion Sc of the section S other than the end portions Sa and Sb (as

shown in Fig. 1). When the adjusting circuit 15 is connected in this way, it is possible to set the welding current for the end portions Sa and Sb to a minimum value Imin and welding current for the intermediate portion Sc to a predetermined value Iw as shown in Fig. 6.

More particularly, the adjusting circuit 15 shown in Fig. 5(a), consists of a first setter 16 for setting a welding current Iw necessary for the welding of the intermediate portion Sc of the overlap section S other than the leading and trailing ends Sa and Sc and a second setter 17 for setting a welding current Imin for welding the leading and trailing end portions Sa and Sb. Thus, the control circuit 7 instructs the welding current source circuit 8 to provide welding current Iw and Imin preset by the first and second setters 16 and 17 in addition to the detection signals of the detectors 6 and 6a. In this case, therefore, the welding current Imin for welding the leading and trailing ends Sa and Sb of the overlap section S has to be set to lower than the welding current Iw for welding the intermediate portion Sc as shown in Fig. 6. In other words, at an instant when the leading end portion Sa of the overlap section S reaches a position somewhat ahead of the welding start line L connecting the axes of the roller electrodes 1 and 2, the leading end portion Sa is already in contact with the electrodes rollers 1 and 2 via wire electrodes 3 to cause welding

curr nt, and th r sistance heat produced in junction surface flows only in the direction of the intermediate portion Sc. Further, for the end portion Sb of the overlap section S it is necessary to set the welding currents to be Iw > Imin in order to meet the welding conditions of the end portion Sb and intermediate portion Sc. In this case, with the adjusting circuit 15 having the above construction as shown in Fig. 5(a), the welding current Imin set by the second setter 17 is supplied to be between the roller electrodes 1 and 2 before the leading end 4a of the process material 4 reaches the line L connecting the axes of the shafts 1a and 2a of the roller electrodes 1 and 2; and during a period from the instant T_1 when the leading end 4a reaches the line L and is detected by the detection switches 6 and 6a till the instant T_3, the welding current Iw set by the first setter 16 is supplied, whereby the welding of the intermediate portion Sc is effected. Subsequent to the instant T_3 when the intermediate portion Sc passes the line L and the trailing end 4b of the process material 4 passes the line L so that it is detected by the detectors 6 and 6a, the welding current Imin is supplied again.

Further, the first and second setters 16 and 17 of the adjusting circuit 15 may be provided in an interlocked relation to one another as shown in Fig. 5(b) instead of providing then independently of each other as shown in

Fig. 5(b).

More specifically, in adjusting circuit 15 shown in Fig. 5(a), the individual setters 16 and 17 are constructed independently of each other. Therefore, it is necessary to adjust the welding current Imin after the adjustment of the welding current Iw for the actual welding of the process material 4. This means that the operations of adjusting welding current with changes in various welding conditions are time-consuming and complicated.

In contrast, in Fig. 5(b), to set the welding current Iw, like the case of Fig. 5(a), a first fixed terminal 16a at one end of resistor in the first setter 16 which is constituted by a variable resistor, is held at a constant voltage of +V, a second fixed terminal 16b at the other end of the resistor is grounded, and a slide terminal 16c connected to slide terminal in the first setter 16 is connected to an input terminal of a buffer amplifier A_1 in the control circuit 7. To set the welding current Imin, in the second setter 17 constituted by a variable resistor a second fixed terminal 17b is grounded, a slide terminal 17c is connected to an input terminal of a buffer amplifier A_2 in the control circuit 7, but a first fixed terminal 17a is connected to the output terminal of the buffer amplifier A_1. The buffer amplifiers A_1 and A_2 are set such that the outputs of the

first and s cond sett rs 16 and 17 are not influ nced by variations of the load impedance.

When the adjustment of the first setter 16 is done with the above construction, a voltage obtained as a result of the vision of the constant voltage +V as reference according to the position of the slide terminal is provided as a first preset voltage V_1. When the second setter 17 is adjusted, a voltage obtained as a result of division of the first preset voltage V_1 provided as reference voltage from the first setter 16 according to the position of the slide terminal is provided as a second preset voltage V_2. Thus, when the first setter 16 is adjusted, the preset voltage V_2 provided from the second setter 17 is varied proportionally. In this case, the preset voltage V_2 has a value equal to the preset voltage V_1 multiplied by a given factor of 0 to 1.0. Thus, once the first and second setters 16 and 17 are adjusted to provide proper welding conditions, only the first setter 16 has to be adjusted for the adjustment of the welding current accompanying a subsequent change in the welding conditions.

INDUSTRIAL UTILITY

As has been described in detail in the foregoing, according to the invention there is provided an apparatus

for seam welding, in which a metal plate or a surface-clad metal plate in cylindrical form with a strip-like overlap section constituted by two overlapping edge portions is passed between pair roller electrodes via upper and lower wire electrodes for seam welding of overlap section between the roller electrodes and also between the upper and lower wire electrodes under pressure applied to the section, and also which is provided with a welding current source for supplying a welding current between the welding electrodes, and in which a detector for detecting at least the leading end of the material being fed is provided on a straight line connecting the axes of rotation of the roller electrodes, and the output side of the detector is connected to a control circuit, which counts the start and stop timings of supply of welding current to the roller electrodes and instructs the start and stop of the welding current supply to the welding current source according to the counted start and stop timings.

Thus, the detector can accurately detect the reaching of at least the leading end of the process material to the position between the roller electrodes at all time, and as a result it is possible to provide a welding current between the roller electrodes at satisfactory timing and obtain satisfactory seam welding.

Further, the invention is applicable to any process material other than that in the cylindrical form as well

so l ng as it has an ov rlap secti n.

WHAT IS CLAIMED IS:

1. An apparatus for seam welding, in which a metal plate or a surface-clad metal plate in a cylindrical form with a strip-like overlap section constituted by two overlapping edge portions is passed as press material between pair roller electrodes via upper and lower wire electrodes for seam welding of said overlap section between said roller electrodes and also between said upper and lower wire electrodes under pressure applied to said section, and also which is provided with a welding current source for supplying a welding current between said roller electrodes, said apparatus comprising a detector disposed at a position on a line connecting the axes of rotation of said roller electrodes for detecting at least the front end of said process material and a control circuit connected to the output side of said detector for counting the start and stop timings of supply of welding current to said roller electrodes and instructing the start and stop of the welding current supply to said welding current source according to the counted start and stop timings.

2. The apparatus for seam welding according to claim 1, which further comprises a feeder for feeding said overlap section into between said roller electrodes by pushing the trailing end of said process material, said feeder including a disk-like member rotatable about a

shaft, a slit provided in said disk-like member and a feed arm having one end mounted on said shaft, and an approach switch provided for detecting the position of said slit, the output side of said approach switch being connected to the control said control circuit.

3. The apparatus for seam welding according to claim 1, which further comprises a feeder for feeding said overlap section into between said roller electrodes by pushing the trailing end of said process material, said feeder including a disk-like member rotatable about a shaft, a slit provided in said disk-like member and a feed arm having one end mounted on said shaft, an approach switch provided for detecting the position of said slit, the output side of said approach switch being connected to said control circuit, and a detector for detecting at least the leading end of said process material, said detector being provided at a position spaced apart from the line connecting the axes of rotation of said roller electrodes in the direction opposite to the direction of feeding of said process material by a predetermined distance smaller than the length dimension of said process material.

4. The apparatus for seam welding according to claim 1, which further comprises an adjusting circuit connected to said control circuit for s tting a welding current necessary for the welding of the intermediate said overlap

section of said process material except for th pposite ends of said section and also a welding current necessary for welding the opposite end portions of said overlap section of said process material.

5. The apparatus for seam welding according to claim 1, which further comprises an adjusting circuit connected to said control circuit for setting a welding current necessary for welding the intermediate portion of said overlap section of said process material except for opposite end portions, setting a welding current necessary for welding said opposite end portions of said overlap section of said process material and setting a welding current necessary for welding said opposite end portions of said overlap section according to the welding current necessary for welding the intermediate portion of said overlap section except for the opposite end portions.

Fig. 1

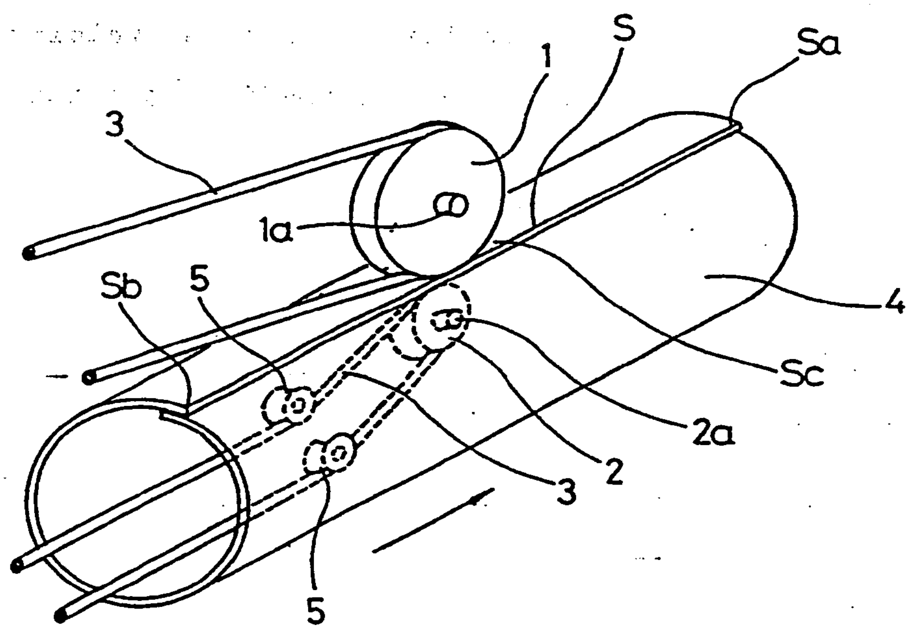


Fig. 2

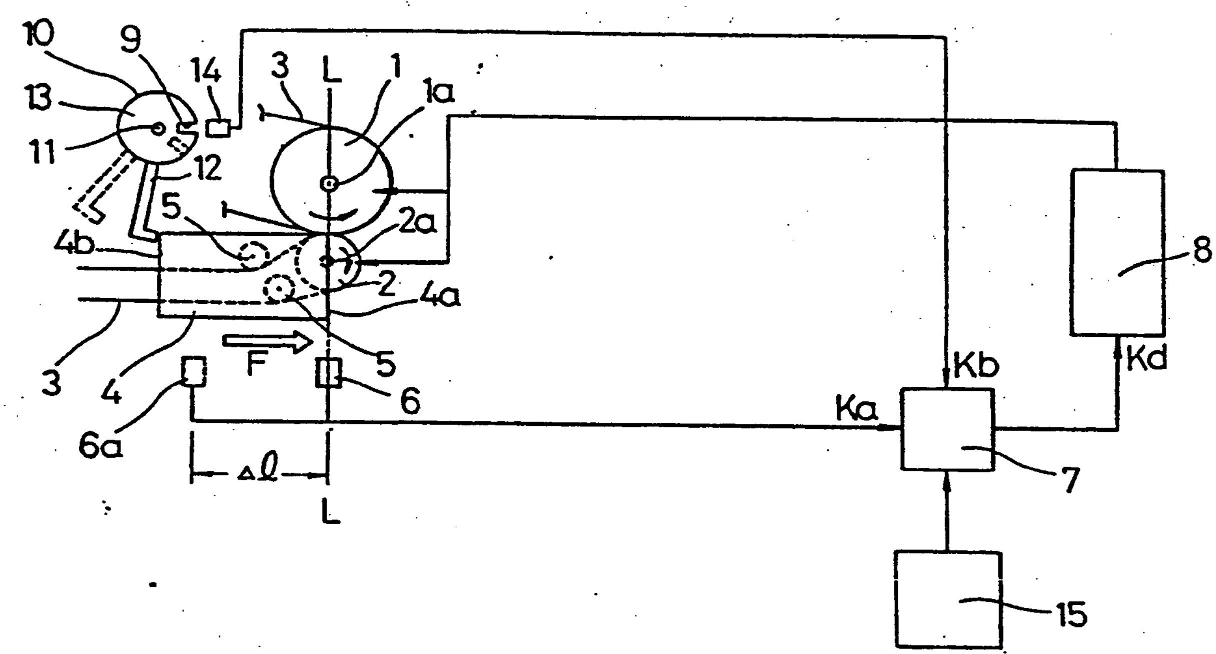


Fig. 3

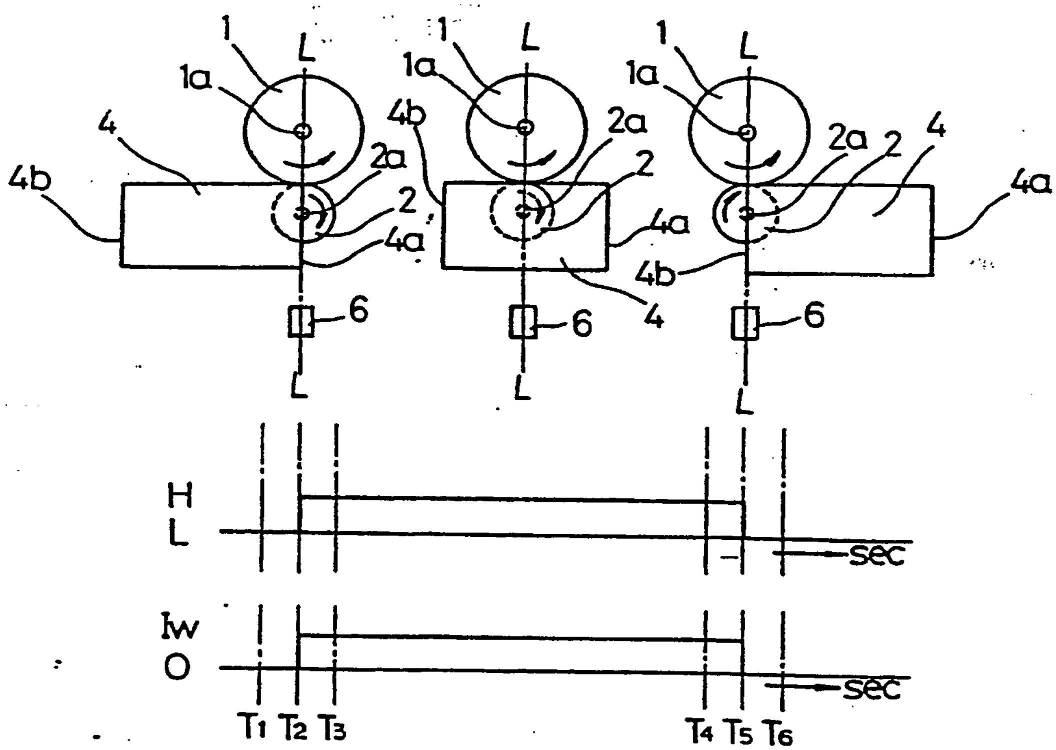
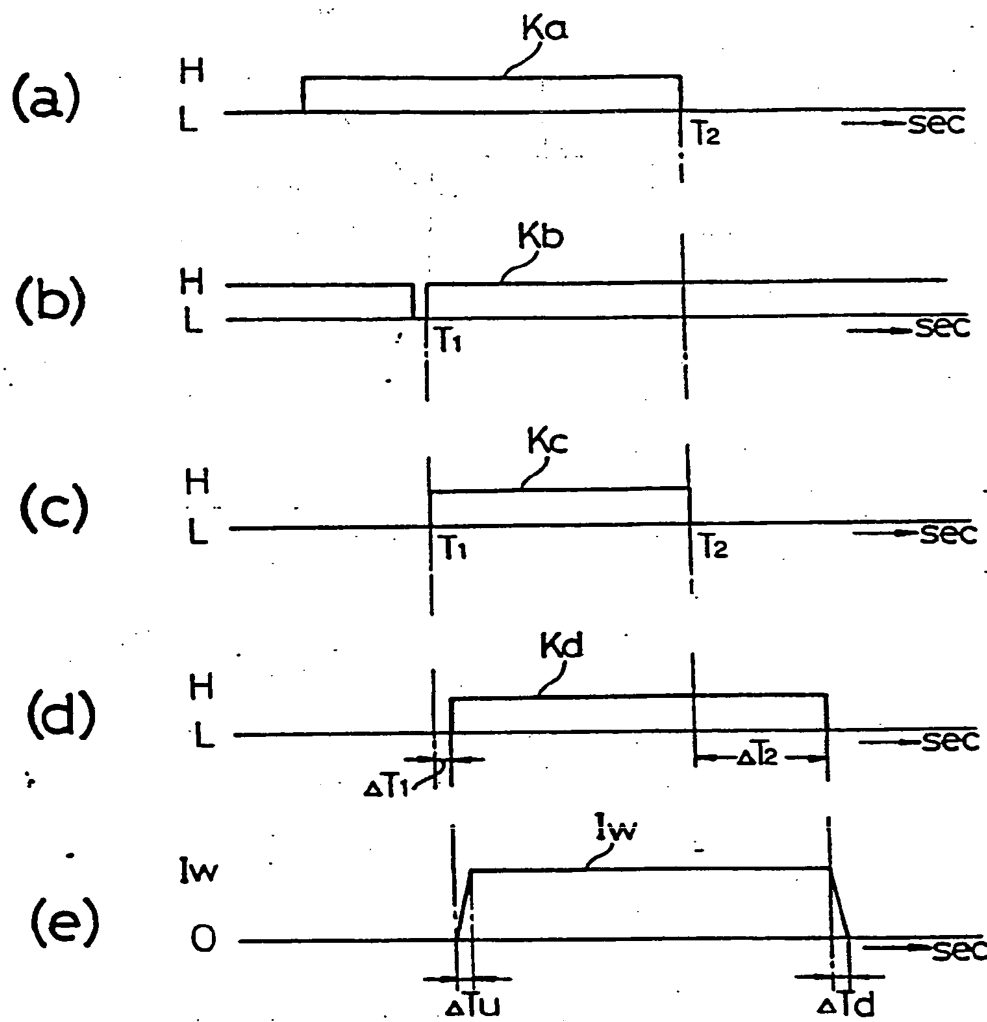


Fig. 4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Ka
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sec
(b)
H
L
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T1
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T1
T2
sec
(d)
H
L
Kd
ΔT1
ΔT2
sec
(e)
Iw
O
Iw
ΔTu
ΔTd
sec

Fig. 5(a)

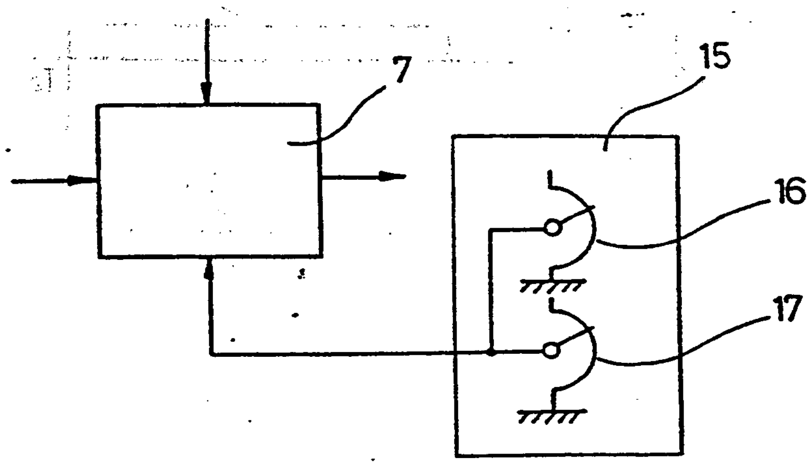


Fig. 5(b)

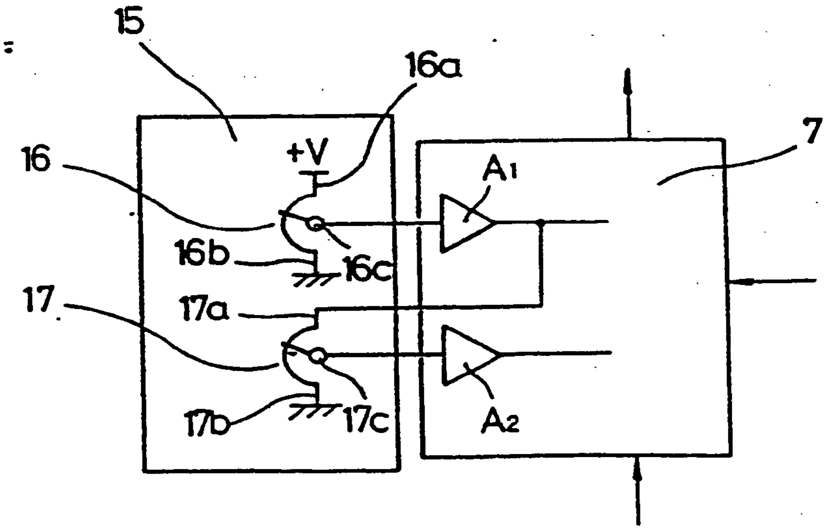
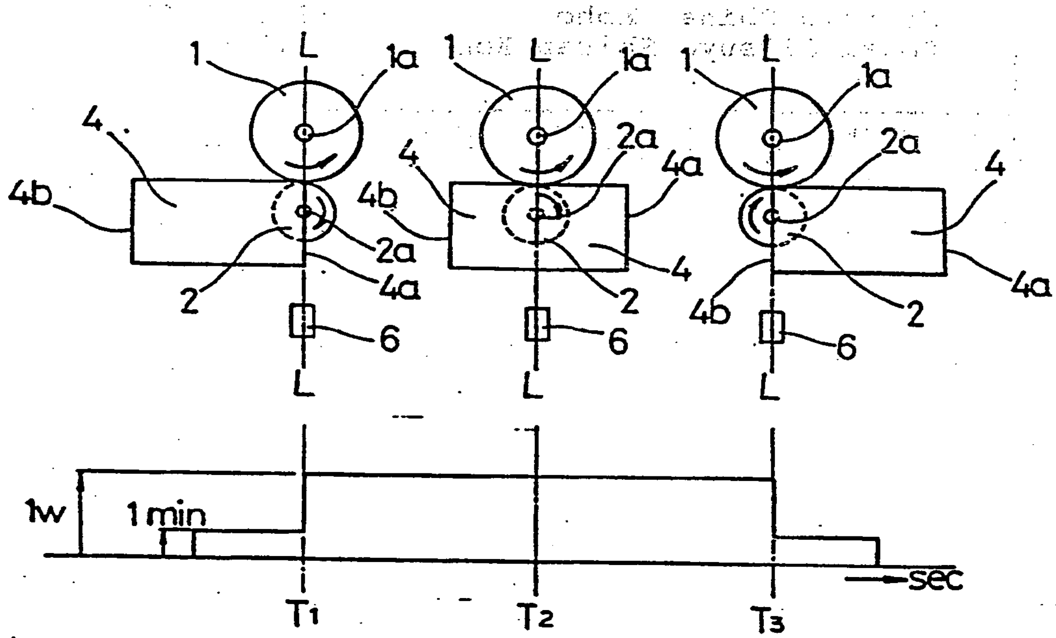


Fig. 6



0273984

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP87/00481

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [8]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl^4 B23K11/24

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC	B23K11/24, 11/06, 11/08

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

Jitsuyo Shinan Koho	1926 - 1987
Kokai Jitsuyo Shinan Koho	1971 - 1987

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	JP, B2, 60-24749 (Hitachi, Ltd.) 14 June 1985 (14. 06. 85) & JP, A, 54-72737	1
X	JP, B2, 61-24112 (Fael S.A.) 9 June 1986 (09. 06. 86) & NL, A, 7507444 & DE, A1, 2525502 & FR, A1, 2275269 & CH, A, 572375 & JP, A, 51-29345 & GB, A, 1509416 & US, A, 4144440 & FR, B1, 2275269	1
Y	JP, B2, 59-19796 (Matsushita Electric Ind. Co., Ltd.) 8 May 1984 (08. 05. 84) & JP, A, 56-168974	4, 5
Y	JP, B2, 60-25233 (Matsushita Electric Ind. Co., Ltd.) 17 June 1985 (17. 06. 85) & JP, A, 57-127585	4, 5

* Special categories of cited documents: [15]

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
September 14, 1987 (14. 09. 87)	September 28, 1987 (28. 09. 87)
International Searching Authority [1]	**Signature of Authorized Officer** [20]
Japanese Patent Office	

Form PCT/ISA/210 (second sheet) (October 1977)